Title
Patterns of Exposure to Cumulative Risk Through Age 2 and Associations with Problem Behaviors at Age 4.5: Evidence from Growing Up in New Zealand.

Journal
Journal of abnormal child psychology, 47(8)

ISSN
0091-0627

Authors
Wallander, Jan L
Berry, Sarah
Carr, Polly Atatoa
et al.

Publication Date
2019-08-01

DOI
10.1007/s10802-019-00521-w

Peer reviewed

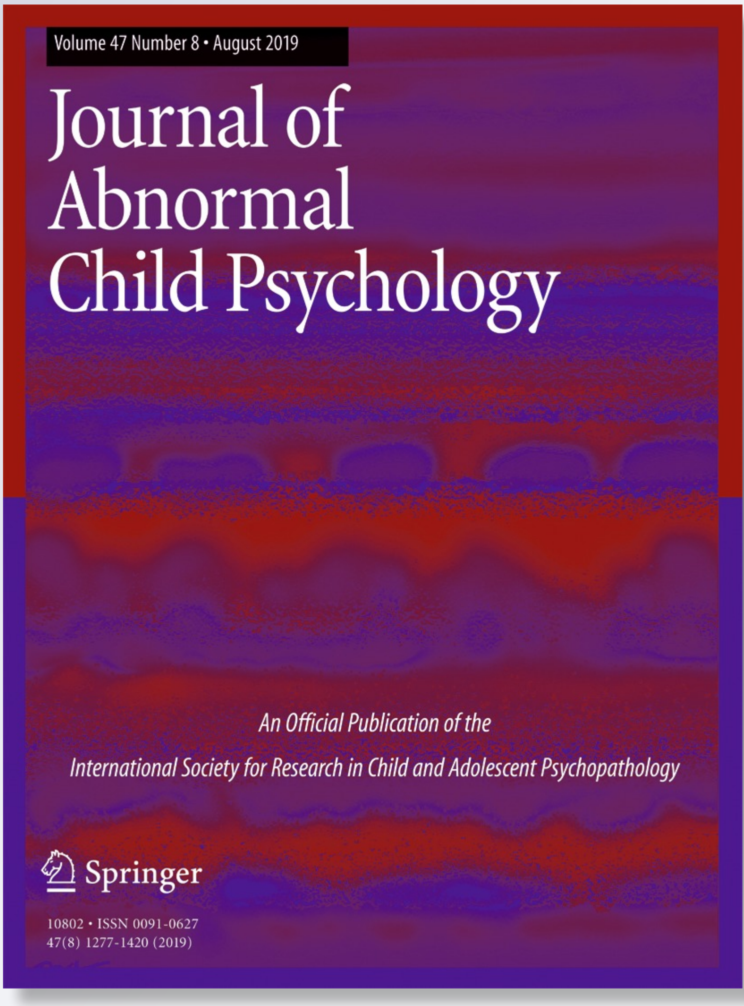
Patterns of Exposure to Cumulative Risk Through Age 2 and Associations with Problem Behaviors at Age 4.5: Evidence from Growing Up in New Zealand

Jan L. Wallander, Sarah Berry, Polly Atatoa Carr, Elizabeth R. Peterson, Karen E. Waldie, Emma Marks, Stephanie D'Souza, et al.

Journal of Abnormal Child Psychology
An official publication of the International Society for Research in Child and Adolescent Psychopathology

ISSN 0091-0627
Volume 47
Number 8

J Abnorm Child Psychol (2019)
47:1277-1288
DOI 10.1007/s10802-019-00521-w



Journal of Abnormal Child Psychology (2019) 47:1277–1288
https://doi.org/10.1007/s10802-019-00521-w

Patterns of Exposure to Cumulative Risk Through Age 2 and Associations with Problem Behaviors at Age 4.5: Evidence from *Growing Up in New Zealand*

Jan L. Wallander[1] · Sarah Berry[2] · Polly Atatoa Carr[2] · Elizabeth R. Peterson[3] · Karen E. Waldie[3] · Emma Marks[2] · Stephanie D'Souza[3] · Susan M. B. Morton[2]

Published online: 21 February 2019

Abstract
Exposure to cumulative risk (CR) has important implications for child development, yet little is known about how frequency, persistence, and timing of CR exposure during early childhood predict behavioral problems already before school start. We examine prospective longitudinal associations between patterns of CR exposure from third trimester through 2 years and subsequent behavior problems at 4.5 years. In 6156 diverse children in the Growing Up in New Zealand longitudinal study, the presence of 12 risk factors, spanning maternal health, social status, and home and neighborhood environment, defined CR and were assessed at last trimester and 9 months and 2 years of age. At child age 4.5 years, mothers completed the Strengths and Difficulties Questionnaire, where a score ≥ 16 indicated an abnormal level of problem behaviors (ALPB). Children exposed to a CR ≥ 1 at least once in early development, compared to those with consistent CR = 0, showed a significantly higher likelihood of ALPB at 4.5 years. Consistent high exposure to CR ≥ 4 across all three assessments had the highest prevalence (44%) of ALPB at age 4.5. Children with high CR exposure on two of three, compared to on all three, time points in early development did not evidence a significantly reduced prevalence (32%–41%) of ALPB. The common co-occurrence of risk factors and their significant developmental impact when accumulated early in life underscore the need for systematic multisector intervention and policy implementation during pregnancy and shortly after birth to improve outcomes for vulnerable children.

Keywords Risk factors · Cumulative risk · Early childhood · Behavior problems · Longitudinal

Introduction

A risk factor refers to any individual or environmental factor associated with the increased likelihood of developing a negative or undesirable outcome. Rutter and others originally observed that the subset of children experiencing multiple risk factors were much more likely to exhibit problems in development than those who did not (Rutter 1979, 1981). The cumulative risk (CR) model is the most common approach to examining the impact of multiple risk factors on children's development, where the number of risks factors experienced is examined rather than the intensity of or unique risk exposures (Evans et al. 2013). CR models define risk factors dichotomously (e.g., maternal depression symptom reporting above clinical cut-off equals risk for a child whereas reporting below this cut-off equals no risk) and then the number are summed across different dichotomous risk factors. The particular combination of risk factors is typically ignored. Indeed, the particular clusters of risk factors appear less important for developmental impact than the number of factors to which a child is exposed (Deater-Deckard et al. 1998; Evans 2003).

Rationale for Cumulative Risk Approach

Whereas there are several methodological advantages with formulating a CR score, the primary substantive reason for the widespread use of CR metrics in developmental

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10802-019-00521-w) contains supplementary material, which is available to authorized users.

✉ Jan L. Wallander
jwallander@ucmerced.edu

[1] Psychological Sciences and Health Sciences Research Institute, University of California, Merced, 5400 North Lake Rd., Merced, CA 95343, USA

[2] School of Population Health and Center for Longitudinal Research He Ara ki Mua, University of Auckland, Auckland, New Zealand

[3] School of Psychology, Faculty of Science, University of Auckland, Auckland, New Zealand

psychology is the consistent finding that multiple, relative to single, risk exposures have worse developmental consequences (Evans et al. 2013). In addition to demonstrating this for increased behavioral and emotional problems (Sameroff et al. 1987), other examples include increased learned helplessness (Evans 2003), smoking in adolescence (Newcomb et al. 1986), reading problems (Luster and McAdoo 1994), and low intellectual functioning (Sameroff 1998). Another reason to study CR exposure is because children often are faced with constellations of risks rather than an isolated instance. Some risk exposures tend to co-occur, for example, low-income household, single-parent family, crowded residence, high crime neighborhood, and low-quality schools (McLoyd 1998; Yoshikawa et al. 2012). Investigation of CR exposure is also valuable because some of the developmental correlates of major sociodemographic factors such as race and social class are explained, in part, by multiple risk factor exposure (Evans and English 2002). Finally, research and theory about CR exposure is important because the number of children confronting multiple risk factors is large and expanding around the world (Grantham-McGregor et al. 2007).

Cumulative Risk and Early Behavior Problems

A primary concern about CR exposure in early childhood is its potential effect on development of behavioral problems. Yet the relationship of CR with behavior disorder occurring already in early childhood has been relatively unexplored. This is vital to examine because behavior disorders can present already in preschool years (Ezpeleta et al. 2014; Poulou 2015), and when they do, there is an increased risk of adverse outcomes later in life (Caspi et al. 1998; Hofstra et al. 2002; Odgers et al. 2007). Thus, it is important to identify as early in life as possible how risk factors contribute to a high level of problem behaviors in early childhood. This in turn can inform efforts to prevent the early development of problem behaviors (Webster-Stratton et al. 2008). Because the occurrence of specific risk factors often differs between children who are considered vulnerable for poor development, prevention strategies might therefore be initiated based on exposure to a certain number of risk factors from a checklist, rather than based on exposure to a specific set of risk factors. For example, additional resources could be provided to children of families that experience four or more risk factors, regardless of which risk factors they experienced (Morton et al. 2014).

Early Exposure to Cumulative Risk

Despite the value of the CR approach, it has rarely been applied in early childhood. Rather, most CR research has focused on school age youth (Evans et al. 2013). Little is known about how different patterns of CR exposure naturally occurs early in children's development. If CR exposure is already present during fetal development, does it tend to persist? What portion of children experience a decrease versus increase in CR exposure during early development? In fact, we are not aware of any research that has considered how different patterns of CR exposure occurring in the critical fetal and early childhood development period predict child outcomes. Does the level of persistence in CR exposure during this early life period matter? Or is high CR exposure at only one time in early development harmful when it does not reoccur? And does it matter when high CR occur in early life, for example in fetal development versus first year or two of life? We do not have a good understanding of how the pattern of occurrence, including persistence and desistance, of CR exposure in early development might affect child development.

Allostatic load is a model (McEwen and Gianaros 2010) that can illuminate how exposure to CR in early childhood can cause developmental disturbances (Ganzel et al. 2010; Juster et al. 2011). Indeed, CR in school age children has been shown to predict allostatic load both concurrently (Evans 2003) and prospectively (Evans et al. 2007). Allostatic load captures the cumulative wear and tear on the body caused by repeated mobilizations of multiple physiological systems over time in response to risk exposure. Accordingly, more frequent and persistent exposure to risk conditions accelerate the wear and tear because a more sustained combination of multiple bodily response systems will be engaged to meet the increased demands. This not only exhausts response system reserves, but more of these interactive response systems will become engaged to meet the combination of demands from exposure to multiple risk factors.

Moreover, if allostatic load occurs repeatedly, the physiological response systems become recalibrated, altering their sensitivity to external demands and remaining on alert. As well, the elasticity of these multiple response systems is compromised because of repeated mobilizations, rendering them less efficient in turning off and returning to a resting state when the demand has ceased. Response capacities are depleted more readily by exposure to CR than by singular risk factor exposure. Drawing from this model, we would expect that persistent CR exposure and CR exposure occurring closer to the developmental outcomes of interest would predict problems in those outcomes.

Study Aims

Most of the evidence for effects of CR stem from cross-sectional studies (Evans et al. 2013). Prospective longitudinal research is needed to advance our understanding how CR exposure in early life is associated with subsequent problematic outcomes in children (Appleyard et al. 2005). In this prospective longitudinal study, we follow over 6800 children first to examine the stability and change in CR exposure from antenatal third trimester through 2 years of age. Second, we examine the prospective longitudinal association between CR exposure in early development and subsequent behavior problems at age 4.5 years. Based on the allostatic load model, we hypothesize that there will be a higher likelihood of an abnormal level of behavior problems at age 4.5 years when: (1) exposure to high CR occurs persistently in early development compared with less frequently or not at all; (2) first exposure to high CR occurs later in this period compared with earlier; and (3) high CR desists later in this period compared with earlier once it is present already prior to birth.

Methods

Participants

Growing Up in New Zealand is a prospective longitudinal cohort study of New Zealand (NZ) children with expected delivery dates between 25th April 2009 and 25th March 2010. Detailed description of study design, recruitment, and demographic composition can be found in Morton et al. (2013, 2015a, b) and at http://www.growingup.co.nz/en.html. Briefly, participants were recruited in their third trimester via 6822 pregnant mothers to provide a socioeconomically and ethnically diverse cohort of 6853 children residing in a contiguous geographical area containing about one third of the NZ birth population. There were no other inclusion or exclusion criteria. Face-to-face interviews were completed with the caregivers (primarily the mothers) of 6476 (95%) of the children at age 9 months, 6327 (92%) at age 2 years, and 6156 (90%) at age 4.5 years. Based on data available from Statistics New Zealand, the demographic characteristics of the mothers in the cohort are comparable with those of all NZ parents on maternal age, ethnicity, parity and socioeconomic status (Morton et al. 2013). Furthermore, the cohort showed generally close alignment to all NZ births between 2007 and 2010 on several birth characteristics and child sex (Morton et al. 2015a, b). Allowing for multiethnic identification, mothers indicated at the 2-year assessment that the children were 71% European, 24% Maori, 20% Pacific People, 16% Asian, and 3% other ethnicities. Children were 42% first born and 65% of participating caregivers were born in NZ.

Procedures

Ethical approval for the study was obtained from the Ministry of Health Northern Y Regional Ethics Committee (NTY/08/06/055). Written informed consent was obtained from all participating women. Longitudinal data collection in the study applied a variety of procedures to obtain information in six inter-connected domains of child development: health and wellbeing; psychological and cognitive development; education; family and whānau (extended family); culture and identity; and neighborhoods and the societal context. The following measures are relevant for the present study.

Measures

Risk Factors Defined in Table 1 comprised the cumulative risk (CR) index and were assessed at the antenatal, 9 month, and 2 year assessments (Morton et al. 2014). These sociodemographic and maternal health variables were selected based on previous use in international studies to define markers of disadvantage and vulnerability for poor outcomes throughout the life course, as well as to be age and context appropriate (Sabates and Dex 2012), available through routine data gathering, and measurable in a standard way across populations (Morton et al. 2014). Ten of these 12 risk factors were measured with single questionnaire items administered to the mother, as noted in Table 1, leaving two exceptions:

Maternal depression was assessed with the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al. 1987), a screening tool consisting of 10 self-report items focused on the cognitive and affective features of depression. With a maximum score of 30 (each item scored 0–3), a score ≥ 13 is considered to indicate significant depressive symptoms. At this cut-off, the EPDS has satisfactory sensitivity (79%) and specificity (85%) for clinical depression in non-postnatal women (Cox et al. 1996).

Neighborhood deprivation was based on the NZDep2006 Index (Salmond et al. 2007) matched to the mother's residence tract. This is an area-level measure of neighborhood population SES, determined using indicators from the 2006 NZ census. Area level deprivation scores range from least (decile 1) to most (decile 10) deprived. Here neighborhood deprivation was classified as high at deciles 9–10, which by definition identifies the neighborhoods of 20% of the population as deprived.

CR Exposure Development Patterns Were then classified based on level of CR by counting the number of risk factors present separately at each assessment. Exposure to a CR ≥ 4 was defined as High CR as this identified approximately the top 10% of children in exposure to CR at each assessment. CR between 1 and 3 defined Medium CR and the presence of 0 CR defined Zero CR, either of which captured about 45% of children at an assessment. Seven developmental patterns can be classified involving exposure to High CR on at least one the three assessments (e.g., High/High/High; Medium/High/Medium; Zero/Medium/High), as shown in Table 3 (see columns labeled CR Level). The seven patterns including any exposure to High CR accounted for 18% of the children, with each specific pattern including 1–5%. The remaining 82% without any High CR exposure at any assessment was

Table 1 Definition and prevalence of each risk factor in the total sample (and those with high cumulative risk)

Risk factor	Definition	Prevalence (%)		
		Antenatal	9 months	2 years
Maternal depression	EPDS ≥13, indicating likely depression	11.6 (37.5[b])	7.6 (27.0[b])	N/A
Maternal low health	Self-rated health = "fair" or "poor"	9.2 (33.1[b])	9.2 (26.6[a])	N/A
Maternal smoking	Smoke "regularly/every day"	9.8(47.4[b])	13.3 (58.4[b])	13.0 (55.0[b])
Maternal young age	Age ≤ 19 at pregnancy	4.0 (21.4[c])	N/A	N/A
Maternal single status	No current partner	8.5 (42.5[c])	8.1 (38.6[b])	9.6 (44.6[b])
Maternal low education	No formal secondary school qualification	6.1 (31.0[c])	N/A	N/A
Maternal financial stress	Reporting "highly stressful" money problems	17.0 (47.8[a])	14.3 (39.8[a])	16.8 (45.5[a])
Maternal unemployment	Not on leave, actively seeking work, but not employed	7.2 (32.0[b])	5.9 (21.6b)	6.9 (25.3[b])
Income tested benefit	Receiving income tested government benefit	13.6 (67.4[c])	16.7 (75.2[b])	15.5 (75.1[b])
Public housing residence	Residing in public/social housing	6.2 (36.2[c])	5.9 (34.2[c])	5.5 (30.7[c])
Overcrowded residence	≥ 2 persons per bedroom	11.9 (40.3[b])	19.7 (56.4[a])	19.2 (53.4[a])
Neighborhood deprivation	Residing in NZ Deprivation (2006) area deciles 9 or 10	24.5 (71.8[a])	24.2 (72.5[a])	24.1 (67.8[a])

Prevalence in parentheses is for participants with High (≥4) Cumulative Risk (CR); *N/A* not assessed, *EPDS* Edinburgh Postnatal Depression Scale, *NZ* New Zealand

[a] Prevalence in High CR is ≤3 times higher than that observed in the total sample

[b] Prevalence in High CR is >3 times but <5 times higher than that observed in the total sample

[c] Prevalence in High CR is ≥5 times higher than that observed in the total sample

classified into two patterns, divided into 30% who were exposed to Zero CR at *each* assessment (i.e., Zero/Zero/Zero) and 52% who had no High CR exposure at any time, but were not at the stable Zero CR exposure (e.g., Medium/Zero/Zero, Zero/Medium/Medium). Thus, nine patterns were used exhaustively to classify all children's CR exposure across three assessments in early life.

Problem Behaviors Were measured at 4.5 years of age with the Australian version of the parent-report Strengths and Difficulties Questionnaire (SDQ; Goodman 1997) for ages 4–16. Although the full questionnaire was administered, problem behaviors are indicated by four five-item subscales: emotional symptoms ("many worries or often seems worried," "often unhappy, depressed or tearful"), peer problems ("rather solitary, prefers to play alone," "generally liked by other children" [reversed]), hyperactivity-inattention ("restless, overactive, cannot stay still for long," "easily distracted, concentration wanders"), and conduct problems ("often loses temper," generally well behaved, usually does what adults request" [reversed]). Items are rated on a three-point scale from "not true" (0) to "certainly true" (2). A total difficulties score is the sum (after reverse scoring positive items) of the 20 items constituting these subscales, which ranges 0–40. Following the SDQ authors' guidelines, the total difficulties score can be categorized into an abnormal range comprised as close as possible by 10% of the population. A score of 16 or above was obtained by 12.5% in this sample and defined the classification of abnormal level problem behaviors (ALPB).

Several studies have evaluated the psychometric properties of the SDQ specifically with children in the preschool age range (e.g., Croft et al. 2015; D'Souza et al. 2017). Similar to findings with older children, these psychometric studies generally have shown satisfactory model fit for the original five-factor model (also including pro-social behaviors) for the full SDQ (Dickey and Blumberg 2004), acceptable internal reliability for the SDQ total difficulties scale ($\alpha \geq 0.70$), and results consistent with theoretical expectations to support its validity for screening for behavior disorders (Van Leeuwen et al. 2006; Warnick et al. 2008). Moreover, the SDQ has been validated for use in multiple countries, for example Australia, United Kingdom, and the United States (www.sdqinfo.com). It was preferred for *Growing Up in New Zealand* because, relative to alternatives such as the Child Behavior Checklist, it is shorter, includes positively worded items, is free to access, and is being used in similar epidemiological childhood studies in other countries. Furthermore, using the SDQ is of value especially in the NZ context, as it has been chosen by the Ministry of Health to be part of the "B4 School Check" aimed at identifying health (e.g., vision, hearing) and behavioral problems in children before they start school.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics v23. Prevalence was calculated for exposure to risk factors, CR, CR levels, and CR developmental patterns, as well as changes between CR levels across assessments. Stability of CR exposure was assessed with Spearman's ρ for ranks and for CR level classification with χ^2 and Somers *D* for ordinal associations. Multivariable logistic regression analysis provided the odds of significantly different prevalence of ALPB for different CR developmental patterns. The specific CR developmental patterns included as independent variables and the reference category in the logistic regression varied depending on the stated specific hypothesis being address, as explained in the results. Odds ratios (OR) were computed in each case applying the 95th percentile confidence interval (CI) to establish significance. Because of the large sample size, only $p < 0.005$ are indicated as significant for test statistics. Sensitivity analyses were conducted to evaluate the influence of certain risk exposures on the results. First, maternal low education and maternal young age were excluded from the classification of CR level because these were highly stable exposures. Second, maternal depression was excluded because this has been shown to be associated with higher reporting of children's behavior problems (De Los Reyes and Kazdin 2005). The multivariable logistic regression analysis, as described above, was then repeated in each case.

Results

Descriptive Information on Risk Exposure

The prevalence of exposure to each individual risk factor at each assessment is shown in Table 1. The most commonly occurring risk factor at each assessment was residing in a deprived neighborhood (24%). The second most common risk factor in the antenatal period was mother reporting financial stress (17%), whereas at both 9 month and 2 years living in an overcrowded residence (19–20%) was most common. The distributions of exposure to CR and CR levels are shown in Table 2. The modal CR exposure was zero at antenatal and 2 year assessments, accounting for 43–48% of all children. Another 43–46% was exposed to Medium CR level at any assessment, which was also the modal exposure at 9 months of age. Fewer than 12% of children were exposed to a High CR at any assessment and between 52 and 56% were exposed to at least one risk factor at each assessment.

Also presented in Table 1 is the prevalence of exposure to each risk factor among those classified as High CR at the same assessment. Although residing in a deprived neighborhood had the highest prevalence also in this group at each assessment (68–73%), this was among the smallest order of increase from the prevalence of this risk factor in the total sample, at no more than three times the prevalence. In contrast, several risk factors had a prevalence in the High CR groups that was at least five times that observed in the total sample, including maternal young age (21%), single status (43%), low education (31%), and income tested benefit (67%) at the antenatal assessment, and public housing residence at all three assessments (31–36%).

Stability and Change in CR Exposure

The stability of CR exposure between subsequent assessments was high (Spearman's $\rho = 0.73–0.74$) and decreased only slightly from the antenatal to the 2 year assessment (0.67) (all $ps < 0.001$). The stability of the classification into Zero, Medium, and High CR levels across the assessments was likewise highly significant (all $\chi^2[4] \geq 3062.67$, all $ps < 0.001$; Somers $D = 0.58–0.74$). Despite this relatively high stability of CR exposure, a proportion of children shifted, as shown in Fig. 1, among the CR levels between each assessment, in different patterns into and out of both Zero and High CR levels. For example, 38% desisted High CR exposure between Antenatal and 9 month and another 18% between 9 month and 2 year assessments. Likewise, 17–26% shifted from Zero to Medium or High CR exposure between assessments.

Longitudinal Associations between CR Exposure and Behavior Problems

Mean problem behavior scores on the SDQ and prevalence of scores at ALPB at age 4.5 are reported in Table 3 for each of the nine CR patterns. All seven patterns including any High CR exposure yielded a prevalence of ALPB ≥23%, compared to 13% in the total sample and 4% in those at stable Zero CR. Results are also shown in Table 3 from multivariable logistic regressions comparing the presence of ALPB at each CR pattern, first to the stable Zero CR pattern as the reference (pattern #0, see Table 3). Children with any exposure to High CR across early development (patterns #s 1–7), regardless at

Table 2 Prevalence of cumulative risk exposure in early development

Cumulative risk exposure	Prevalence (%)		
	Antenatal	9 months	2 years
Number of factors			
0	45.3	42.8	47.5
1	23.8	25.0	23.9
2	12.2	12.9	12.6
3	7.2	8.4	7.8
4	5.1	4.9	4.7
5	3.1	3.4	2.3
6	1.8	1.7	1.0
≥ 7	1.7	1.0	0.1
Level (CR range)			
Zero (0)	45.3	42.8	47.2
Medium (1–3)	43.2	46.3	44.3
High (≥4)	11.7	11.0	8.1

CR cumulative risk

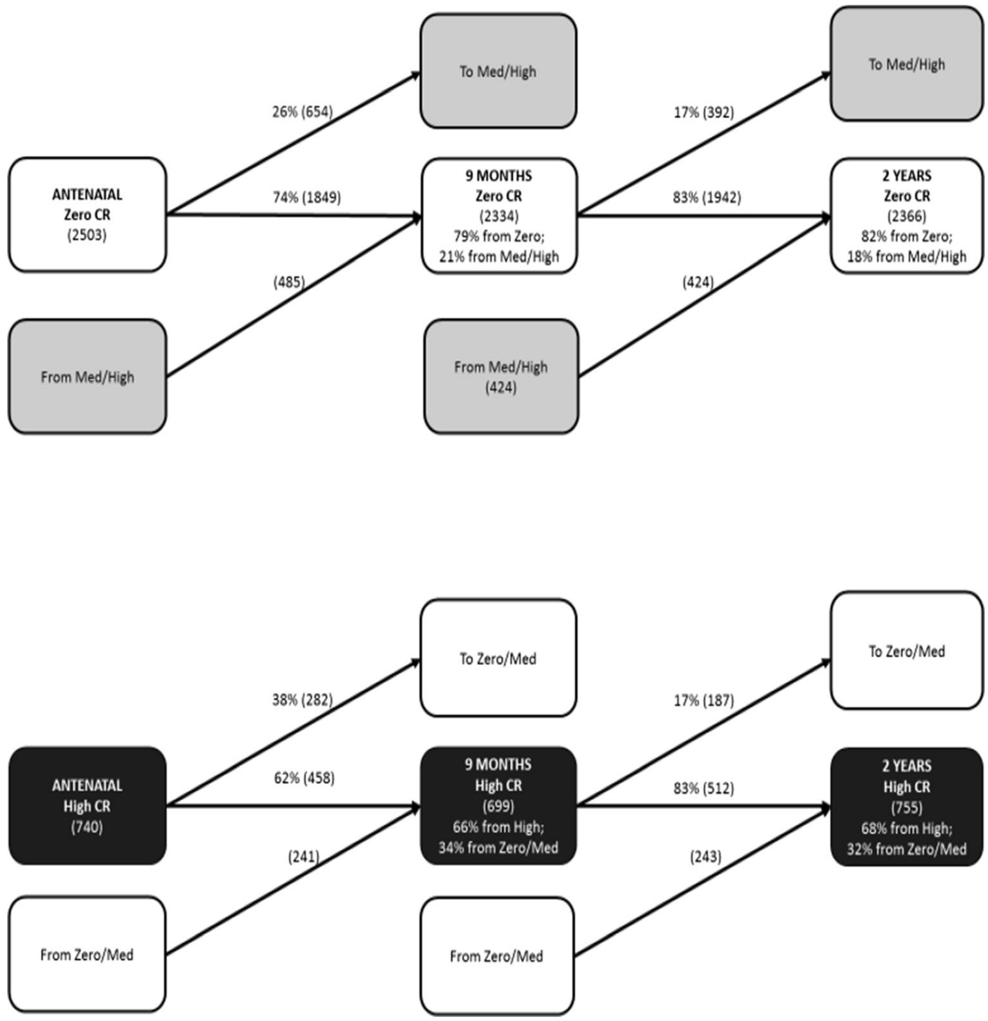


Fig. 1 Movement in and out of Zero (top panel) and High (bottom panel) cumulative risk (CR) level across early development. Numbers in parentheses = *n*. Med = Medium CR level

which time and how frequently the exposure occurred, had a significantly higher likelihood of ALPB at age 4.5 compared to those with Zero CR across all three assessments (all ORs ≥ 7.04, all $ps < 0.001$).

More specifically, those with High CR (≥ 4 risk factors) exposure at all three assessments (#1) had over 21-times the likelihood of ALPB. Children with exposure to High CR at two (but not three) of the assessments (#s 2–4) had between 12- and 18-times the likelihood of ALPB at age 4.5. Even children with Medium CR (1–3 risk factors) exposure at least once (#8), but without any High CR exposure at any time, had over three times the likelihood ($p < 0.001$) of ALPB compared to those with stable Zero CR (#0).

Sensitivity Testing 1 To examine the influence of maternal low education and maternal young age on ALPB, a modified CR index was calculated absent these two risk factors. First, the multivariable logistic regression on ALPB reported in Table 3 was repeated based on this modified CR index. As detailed in Appendix, with stable Zero CR pattern (#0) as the reference, the significance ($p < 0.005$) of all ORs was replicated when maternal low education and maternal young age were removed from the CR classification. A second multivariable logistic regression was conducted based on this same modified CR index, but where maternal low education and maternal young age was included in the logistic regression as covariates, entered on the first step ($R^2 = 0.05$, $p < 0.001$), followed by the eight CR patterns on the second step (incremental $R^2 = 0.13$, $p < 0.001$). As shown in Appendix, with stable Zero CR pattern (#0) as the reference, the significance ($p < 0.005$) of all ORs was again replicated following adjustment for maternal low education and maternal young age. Whereas maternal low education and maternal young age yielded significant ORs when entered on the first step (OR = 3.15 [95% CI = 2.28, 4.44] and OR = 3.68 [95% CI = 2.74, 4.94], respectively), they no longer did so on the second step (OR = 1.25 [95% CI = 0.87, 1.81] and OR = 1.21 [95% CI = 0.88, 1.68], respectively) when the CR patterns were added in the logistic regression.

Table 3 Results from logistic regression of abnormal level problem behaviors at 4.5 years of age on patterns of cumulative risk exposure in early development

CR Pattern					SDQ	SDQ Abnormal Level[a]	Stable Zero CR (#0) as Reference		Stable High CR (#1) as Reference	
#	Antenatal	9 months	2 years	*n (%)*	*M*	%	OR[b]	(95% CI)	OR[b]	(95% CI)
1	High	High	High	317 (5)	14.8	44.4	**21.56**	(15.15, 30.67)	REF	
2	Medium or Zero	High	High	198 (3)	14.0	40.5	**18.36**	(12.29, 27.43)	0.85	(0.58, 1.26)
3	High	Medium or Zero	High	72 (1)	13.9	40.4	**18.27**	(10.14, 32.90)	0.85	(0.47, 1.52)
4	High	High	Medium or Zero	81 (1)	12.2	31.9	**12.64**	(7.16, 22.31)	0.59	(0.33, 1.03)
5	High	Medium or Zero	Medium or Zero	129 (2)	12.5	28.7	**10.87**	(6.66, 17.75)	*0.50*	(0.31, 0.82)
6	Medium or Zero	High	Medium or Zero	103 (2)	11.6	23.1	**8.10**	(4.66, 14.06)	**0.38**	(0.22, 0.65)
7	Medium or Zero	Medium or Zero	High	139 (2)	12.0	20.7	**7.04**	(4.20, 11.82)	**0.33**	(0.20, 0.54)
8	Medium or Zero[c]	Medium or Zero[c]	Medium or Zero[c]	3037 (52)	9.6	10.8	**3.26**	(2.45, 4.33)	**0.15**	(0.12, 0.20)
0	Zero	Zero	Zero	1769 (30)	7.6	3.6	REF		**0.05**	(0.03, 0.07)
	Total sample				9.7	12.5				

CR, cumulative risk; *SDQ*, Strengths and Difficulties Questionnaire at 4.5 years of age; *High*, CR ≥ 4; *Medium*, 1 ≤ CR ≤ 3;Zero = CR = 0 ; *REF*, reference category

[a] SDQ ≥ 16

[b] **bold** indicates significant OR at $p < 0.001$; *italics* indicate significant OR at $p = 0.005$ when compared with reference CR level pattern

[c] Pattern could include Medium or Zero CR exposure but excluded those who consistently had CR = 0 exposure at all 3 assessments, who were instead classified as #0 pattern

Sensitivity Testing 2 To examine the possible influence of maternal depression in the associations between CR and maternal report of child ALPB, a modified CR index was calculated absent this risk factor. The multivariable logistic regression on ALPB reported in Table 3 was then repeated based on this modified CR index. As shown in Appendix, with stable Zero CR pattern (#0) as the reference, the significance ($p < 0.005$) of all ORs was replicated when maternal depression was removed as a risk factor.

H1: Persistence of High CR Exposure

To address Hypothesis 1, another multivariable logistic regression was completed, comparing the same patterns of CR exposure as originally, but where High CR across all assessments (i.e., Stable High #1: 44%) was the reference indicating persistent CR exposure. As detailed in Table 3, none of the patterns involving exposure to High CR at only two of the assessments (#s 2–4) yielded significantly ($p < 0.005$) reduced odds of ALPB at age 4.5 when compared to stable High CR at all three assessments. In contrast, patterns involving High CR exposure on only one occasion (#s 5–7) or none (#8 and #0) yielded reduced likelihood (ORs ≤ 0.50, *p*s ≤ 0.005) of ALPB.

H2: First Exposure to High CR

Two approaches were used to address Hypothesis 2. In the first approach, the three CR patterns that include exposure to High CR at one, and only one, assessment were compared (#s 5–7). When compared to High CR occurring only at the antenatal assessment as the reference (#5: 29%), logistic regressions indicated that there was no difference in the likelihood ALPB at age 4.5 when High CR exposure occurred only at 9 months (#6: 23%, OR = 0.75 [0.39 1.42]) or only at 2 years (#7: 23%, OR = 0.65 [0.35, 1.20]).

In the second approach, another three CR exposure patterns were compared also reflecting differences in the first occurrence of High CR, but in this case that exposure to High CR continued at subsequent assessments. Compared to children who were first exposed to High CR in antenatal period and then continued at this level at the assessments at 9 months and 2 years of age (i.e., Stable High #1: 44%) as the reference, those for whom High CR exposure did not occur first until at 2 years of age (#7) had a significant two-thirds reduction in the likelihood of ALPB at age 4.5 (23%, OR = 0.33 [0.20, 0.54], $p < 0.001$). However, there was no difference in ALPB for children who were first exposed to High CR at 9 months and then continued at this High CR exposure also at 2 years (#2: 41%, OR = 0.85 [0.58, 1.26]) compared to the Stable High reference pattern (#1).

H3: Desistance of High CR Exposure

Once exposure to High CR occurs in the antenatal period, it may desist either at 9 months or 2 years of age.

Hypothesis 3 was tested by comparing children who first encountered High CR exposure in the antenatal period and did not desist (i.e., Stable High #1: 44%) as the reference with those who desisted either before 9 months or 2 years of age. Children for whom exposure desisted before 9 months of age had a 50% reduction in the likelihood ALPB at age 4.5 (#5: 29%, OR = 0.50 [0.31, 0.82], $p = 0.005$). However, there was no difference in the likelihood of ALPB for children whose exposure to High CR did not desist until before 2 years of age (#4: 32%, OR = 0.59 [0.34, 1.03]).

Discussion

There was a significantly higher likelihood of abnormal level of problem behaviors at age 4.5 for children in NZ exposed to a *CR above zero at least once at any tim*e in early development compared to those who consistently experienced no risk exposure. Consistent with hypothesis 1, persistent exposure to a high level of CR was associated with the highest prevalence of significant problem behaviors at age 4.5, which was present in almost one-half of such children. Children with high CR exposure on two out of three assessments in early development did not appear to benefit significantly from their reduced exposure, evidencing a similar likelihood of significant problem behaviors as the persistently high CR exposure group. Rather, the exposure to high CR needed to be reduced to occurring at only one point in early development to be associated with a decreased likelihood of significant problem behaviors compared to the persistently high CR group, but even then, these children evidenced significantly more problem behaviors than those with no risk exposure.

Inconsistent with hypothesis 2, there was no evidence for a critical period for exposure to CR to be associated with a higher likelihood of problem behavior at age 4.5. Regardless whether the CR exposure first occurred in the antenatal period or at 9 months or 2 years of age, there was no difference in the likelihood of significant problem behaviors at 4.5 years of age. However, consistent with hypothesis 3, there was some reduction in problem behaviors associated with exposure to a high level of CR during antenatal period if the high exposure desisted before age 9 months, but not if it continued through this age and did not desist until 2 years of age.

These results concerning the impact of risk factors are important given the proportion of children who are exposed to CR. Over one-half of all children experienced at least one risk factor at some point in early development. Approximately one out of 10 children in NZ are estimated to be exposed to a high level of risk factors at some point in this period, compared to less than one in three who do not experience any of the risk factors at any of the assessments. Whereas the majority of children experienced a stable level of CR exposure over the early years, a proportion changed their exposure across early development. More than one in three experienced a positive shift away from high CR exposure from third trimester to 9 months of age. Yet, about one in four children encountered a negative shift from zero to at least medium CR level. This increased risk exposure was associated with an increased likelihood of significant problem behaviors displayed by start of school.

These results regarding behavioral sequala associated with CR exposure in early development are largely consistent with predictions based on the allostatic load model (McEwen and Gianaros 2010). Whereas previous research has shown that CR in school age children predicts allostatic load both concurrently (Evans 2003) and prospectively (Evans et al. 2007), the present study suggests that CR exposure in early development may also result in increased allostatic load. First, higher CR should increase the probability that multiple response systems will be engaged because they must respond to more than one type of demand. Second, higher CR should also mean that the body will have less down time to restore because it must continue to respond to a higher rate of demands. Compared to a single risk factor, CR is more likely to overwhelm the adaptive capacities of bodily response systems (Evans 2003; Flouri 2008; Sameroff et al. 2004). Future research will need directly to examine allostatic load associated with CR exposure in early development.

Our findings on the negative effects of early exposure to CR can also be related to research into the effects of adverse childhood experiences (ACEs). This approach also examines the accumulation of risk factors, but in contrast to the CR approach, ACEs focuses on a narrower set related to maltreatment and family dysfunction in childhood. Moreover, typically there is no reference to when in development ACEs occurred. A large volume of research consistently reports that accumulation of ACEs predicts physical, psychological, and social problems in adolescence (Flaherty et al. 2013 b) and adulthood (cf. Hughes et al. 2017), including premature death (Brown et al. 2009). Fewer studies have linked ACEs with outcomes earlier in childhood but some have reported associations with behavioral and learning problems, obesity, and poor health (Burke et al. 2011; Flaherty et al. 2006) in elementary school age children. Future research should examine the association between early CR exposure and subsequent ACEs.

Limitations

The determination of children's risk exposure relied on maternal self-report, except for neighborhood deprivation. However, only two of those risk factor did not require maternal reports of objective conditions (e.g., single status, education, income tested benefit), the exceptions being maternal depression and health. Child problem behaviors were measured with a screening tool also completed by the mother, which reflects both child behavior and maternal cognitive and emotional processes in an unknown mixture (De Los Reyes and Kazdin 2005). Mitigating to some extent the reliance on maternal report, sensitivity analysis based on a CR index absent of maternal report of depression replicated the significance of all associations between CR and child behavior problems. The assessment of CR reflected current experience at three specific time points in early development. We do not know what occurs between these snapshot assessments. It is likely risk factors are chronic and continue to be present also at the assessment of problem behaviors over 2 years later. These data were collected in New Zealand, which has a specific mixture of ethnic and migration patterns such that generalizing to other contexts should be done cautiously.

The CR approach has several shortcomings, including risk is designated arbitrarily, information on risk intensity is lost, and the index is additive precluding the possibility of statistical interactions between risk factors (Evans et al. 2013). Moreover, the CR approach is a variable-centered approach, which assumes a homogenous population in which each exposure has equal weight and are interchangeable (Hagan et al. 2016; Houston et al. 2011) and relations between different variables hold across all individuals (Laursen and Hoff 2006). Person-centered methods have been advocated as an alternative, which allow for the identification of subgroups of individuals who share similar risk exposures (Bergman et al. 2003). Person-centered methods use the individual as the unit of analysis and decompose a heterogeneous population into smaller homogenous subpopulations. This has the potential to increases the portion of variance explained and the validity of statements made (von Eye 2010) and generalizability of findings relative to variable-centered investigations (Hagan et al. 2016). It should be useful directly to compare variable- and person-centered approaches in illuminating influences on child development. For example, we found that a set of risk factors was noticeably more prevalent among children exposed during pregnancy to high CR compared to those in the population, including maternal young age, single status, low education, income tested benefit, and public housing residence. Future research may examine if this cluster defines a homogeneous group with predicable developmental sequala beyond what could be predicted from a generically defined high CR group as exemplified in the current study.

Implications

The CR approach has the advantage of being a simple methodology. Counting the number of risk factor exposures and then relating that to developmental outcomes has intuitive appeal and is easily understood. The analysis of CR is also a useful mechanism to understand better the complex context of vulnerable subgroups. For example, children with very young mothers are not vulnerable primarily because of the single risk factor of young maternal age, but because this often co-occurs with other risk factors such as low education, unemployment, and financial stress. Because multiple risk factor exposure nearly always has a greater impact on children than singular risk factor exposure, identification of children confronted by multiple risk factors point to priority candidates for interventions. Given that evidence is amassing that the accumulation of exposure to multiple risk factors is more harmful than exposure to a singular risk factor, interventions or policies that target only a singular risk factor are less likely to be effective. Unfortunately, this is a common pattern in the intervention literature (Sameroff 1998; Yoshikawa et al. 2012). Rather, interventions and policies need to address a range of risk factors with which children must contend. Recognizing the co-occurrence of risk factors and their significant impact in early development should underscore the need for a systematic multisector approach that is required to improve outcomes for vulnerable children as well as equity in society.

Acknowledgements *Growing Up in New Zealand* has been funded by the New Zealand Ministries of Social Development, Health, Education, Justice, and Pacific Island Affairs; the former Ministry of Science Innovation and the former Department of Labour (now both part of the Ministry of Business, Innovation and Employment); the former Ministry of Women's Affairs (now the Ministry for Women); the Department of Corrections; the Families Commission (now known as the Social Policy Evaluation and Research Unit); Te Puni Kokiri; New Zealand Police; Sport New Zealand; the Housing New Zealand Corporation; and the former Mental Health Commission, The University of Auckland and Auckland UniServices Limited. Other support for the study has been provided by the NZ Health Research Council, Statistics New Zealand, the Office of the Children's Commissioner and the Office of Ethnic Affairs.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Appendix

Table 4 Results from sensitivity analyses 1 and 2: Logistic regressions on abnormal level problem behaviors

CR Pattern				Original Analysis (see Table 3)	Sensitivity Analysis 1: Without Maternal Low Education and Young Age in CR Pattern		Sensitivity Analysis 1: Adjusting for Maternal Low Education and Young Age[a]		Sensitivity Analysis 2: Without Maternal Depression in CR Pattern	
#	Ante-natal	9 months	2 years	OR[b]	OR[b]	(95% CI)	OR[b]	(95% CI)	OR[b]	(95% CI)
1	High	High	High	**21.56**	**22.63**	(15.45, 33.14	**20.51**	(13.63, 30.85)	**20.62**	(13.95, 30.48)
2	Medium or Zero	High	High	**18.36**	**18.66**	(12.23, 28.49)	**16.86**	(10.77, 26.39)	**21.20**	(13.10, 34.30)
3	High	Medium or Zero	High	**18.27**	**23.18**	(11.99, 44.81)	**21.51**	(11.00, 42.09)	**20.08**	(11.56, 34.87)
4	High	High	Medium or Zero	**12.64**	**11.62**	(6.18, 21.87)	**11.13**	(5.87, 21.07)	**14.03**	(7.19, 27.40)
5	High	Medium or Zero	Medium or Zero	**10.87**	**10.59**	(6.27, 17.87)	**10.69**	(6.31, 18.11)	**10.42**	(6.07, 17.89)
6	Medium or Zero	High	Medium or Zero	**8.10**	**9.31**	(5.33, 16.26)	**8.78**	(4.97, 15.48)	**8.67**	(4.54, 16.56)
7	Medium or Zero	Medium or Zero	High	**7.04**	**7.04**	(4.13, 12.04)	**6.73**	(3.91, 11.57)	**7.73**	(4.75, 12.58)
8	Medium or Zero[c]	Medium or Zero[c]	Medium or Zero[c]	**3.26**	**3.09**	(2.28, 4.18)	**3.10**	(2.28, 4.21)	**3.06**	(2.26, 4.14)
0	Zero	Zero	Zero	REF	REF		REF		REF	

CR, cumulative risk; *High*, CR ≥ 4; *Medium*, 1 ≤ CR ≤ 3; Zero = CR = 0 across all 3 assessments; *REF*, reference category

[a] CR pattern classification was made without maternal low education and maternal young age and then these two factors were entered as covariates in logistic regression

[b] **bold** indicates significant OR at $p < 0.001$ when compared with reference being stable Zero CR pattern (#0)

[c] Pattern could include Medium or Zero but excluded those who consistently had CR = 0 exposure at all 3 assessments, who were instead classified as #0 pattern

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

References

Appleyard, K., Egeland, B., van Dulmen, M. H. M., & Sroufe, L. A. (2005). When more is not better: The role of cumulative risk in child behavior outcomes. *Journal of Child Psychology and Psychiatry, 46*, 235–245. https://doi.org/10.1111/j.1469-7610.2004.00351.x.

Bergman, L. R., Magnusson, D., & El Khouri, B. M. (2003). Studying individual development in an interindividual context: A person-oriented approach. Psychology Press.

Brown, D. W., Anda, R. F., Tiemeier, H., Felitti, V. J., Edwards, V. J., Croft, J. B., & Giles, W. H. (2009). Adverse childhood experiences and the risk of premature mortality. *American Journal of Preventive Medicine, 37*, 389–396. https://doi.org/10.1016/j.amepre.2009.06.021.

Burke, N. J., Hellman, J. L., Scott, B. G., Weems, C. F., & Carrion, V. G. (2011). The impact of adverse childhood experiences on an urban pediatric population. *Child Abuse & Neglect, 35*, 408–413. https://doi.org/10.1016/j.chiabu.2011.02.006.

Caspi, A., Moffitt, T. E., & Newman, D. L. (1998). Behavioral observations at age 3 years predict adult psychiatric disorders. *Annual Progress in Child Psychiatry and Child Development, 1997*, 319–332.

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh postnatal depression scale. *The British Journal of Psychiatry, 150*, 782–786. https://doi.org/10.1192/bjp.150.6.782.

Cox, J. L., Chapman, G., Murray, D., & Jones, P. (1996). Validation of the Edinburgh postnatal depression scale (EPDS) in non-postnatal women. *Journal of Affective Disorders, 39*, 185–189. https://doi.org/10.1016/0165-0327(96)00008-0.

Croft, S., Stride, C., Maughan, B., & Rowe, R. (2015). Validity of the strengths and difficulties questionnaire in preschool-aged children. *Pediatrics, 135*, e1210–e1219. https://doi.org/10.1542/peds.2014-2920.

D'Souza, S., Waldie, K. E., Peterson, E. R., Underwood, L., & Morton, S. M. (2017). Psychometric properties and normative data for the preschool strengths and difficulties questionnaire in two-year-old children. *Journal of Abnormal Child Psychology, 45*, 345–357. https://doi.org/10.1007/s10802-016-0176-2.

De Los Reyes, A., & Kazdin, A. E. (2005). Informant discrepancies in the assessment of childhood psychopathology: A critical review, theoretical framework, and recommendations for further study. *Psychological Bulletin, 131*, 483–509. https://doi.org/10.1037/0033-2909.131.4.483.

Deater-Deckard, K., Dodge, K. A., Bates, J. E., & Pettit, G. S. (1998). Multiple risk factors in the development of externalizing behavior problems: Group and individual differences. *Development and Psychopathology, 10*, 469–493. https://doi.org/10.1017/S0954579498001709.

Dickey, W. C., & Blumberg, S. J. (2004). Revisiting the factor structure of the strengths and difficulties questionnaire: United States, 2001. *Journal of the American Academy of Child & Adolescent Psychiatry, 43*, 1159–1167. https://doi.org/10.1097/01.chi.0000132808.36708.a9.

Evans, G. W. (2003). A multimethodological analysis of cumulative risk and allostatic load among rural children. *Developmental Psychology, 39*, 924–933. https://doi.org/10.1037/0012-1649.39.5.924.

Evans, G. W., & English, K. (2002). The environment of poverty: Multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child Development, 73*, 1238–1248. https://doi.org/10.1111/1467-8624.00469.

Evans, G. W., Kim, P., Ting, A. H., Tesher, H. B., & Shanis, D. (2007). Cumulative risk, maternal responsiveness, and allostatic load among young adolescents. *Developmental Psychology, 43*, 341–351. https://doi.org/10.1037/0012-1649.43.2.341.

Evans, G. W., Li, D., & Whipple, S. S. (2013). Cumulative risk and child development. *Psychological Bulletin, 139*, 1342–1396. https://doi.org/10.1037/a0031808.

von Eye, A. (2010). Developing the person-oriented approach: Theory and methods of analysis. *Development and Psychopathology, 22*, 277–285. https://doi.org/10.1017/S0954579410000052.

Ezpeleta, L., de la Osa, N., & Doménech, J. M. (2014). Prevalence of DSM-IV disorders, comorbidity and impairment in 3-year-old Spanish preschoolers. *Social Psychiatry and Psychiatric Epidemiology, 49*, 145–155. https://doi.org/10.1007/s00127-013-0683-1.

Flaherty, E. G., Thompson, R., Litrownik, A. J., Theodore, A., English, D. J., Black, M. M., ... & Dubowitz, H. (2006). Effect of early childhood adversity on child health. *Archives of Pediatrics & Adolescent medicine, 160*, 1232–1238. https://doi.org/10.1001/archpedi.160.12.1232.

Flaherty, E. G., Thompson, R., Dubowitz, H., Harvey, E. M., English, D. J., Proctor, L. J., & Runyan, D. K. (2013). Adverse childhood experiences and child health in early adolescence. *JAMA Pediatrics, 167*, 622–629. https://doi.org/10.1001/jamapediatrics.2013.22.

Flouri, E. (2008). Contextual risk and child psychopathology. *Child Abuse & Neglect, 32*, 913–917. https://doi.org/10.1016/j.chiabu.2007.12.008.

Ganzel, B. L., Morris, P. A., & Wethington, E. (2010). Allostasis and the human brain: Integrating models of stress from the social and life sciences. *Psychological Review, 117*, 134–174. https://doi.org/10.1037/a0017773.

Goodman, R. (1997). The strengths and difficulties questionnaire: A research note. *Journal of Child Psychology and Psychiatry, 38*, 581–586.

Grantham-McGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., Strupp, B., & International Child Development Steering Group. (2007). Developmental potential in the first 5 years for children in developing countries. *The Lancet, 369*, 60–70.

Hagan, M. J., Sulik, M. J., & Lieberman, A. F. (2016). Traumatic life events and psychopathology in a high risk, ethnically diverse sample of young children: A person-centered approach. *Journal of Abnormal Child Psychology, 44*, 833–844. https://doi.org/10.1007/s10802-015-0078-8.

Hofstra, M. B., Van Der Ende, J., & Verhulst, F. C. (2002). Child and adolescent problems predict DSM-IV disorders in adulthood: A 14-year follow-up of a Dutch epidemiological sample. *Journal of the American Academy of Child & Adolescent Psychiatry, 41*, 182–189. https://doi.org/10.1097/00004583-200202000-00012.

Houston, J. E., Shevlin, M., Adamson, G., & Murphy, J. (2011). A person-centred approach to modelling population experiences of trauma and mental illness. *Social Psychiatry and Psychiatric Epidemiology, 46*, 149–157. https://doi.org/10.1007/s00127-009-0176-4.

Hughes, K., Bellis, M. A., Hardcastle, K. A., Sethi, D., Butchart, A., Mikton, C., et al. (2017). The effect of multiple adverse childhood experiences on health: A systematic review and meta-analysis. *The Lancet Public Health, 2*, e356–e366. https://doi.org/10.1016/S2468-2667(17)30118-4.

Juster, R. P., Bizik, G., Picard, M., Arsenault-Lapierre, G., Sindi, S., Trepanier, L., . . . Lupien, S. J. (2011). A transdisciplinary perspective of chronic stress in relation to psychopathology throughout life span development. Development and Psychopathology, 23, 725–776. https://doi.org/10.1017/S0954579411000289.

Laursen, B., & Hoff, E. (2006). Person-centered and variable-centered approaches to longitudinal data. *Merrill-Palmer Quarterly, 52*, 377–389. https://www.jstor.org/stable/23096200.

Luster, T., & McAdoo, H. P. (1994). Factors related to the achievement and adjustment of young African American children. *Child Development, 65*, 1080–1094. https://doi.org/10.2307/1131306.

McEwen, B. S., & Gianaros, P. J. (2010). Central role of the brain in stress and adaptation: Links to socioeconomic status, health, and disease. *Annals of the New York Academy of Sciences, 1186*, 190–222. https://doi.org/10.1111/j.1749-6632.2009.05331.x.

McLoyd, V. C. (1998). Socioeconomic disadvantage and child development. *American Psychologist, 53*, 185–204. https://doi.org/10.1037/0003-066X.53.

Morton, S. B. M., Atatoa Carr, P. E., Grant, C. C., Robinson, E. M., Bandara, D. K., Bird, A., et al. (2013). Cohort profile: Growing up in New Zealand. *International Journal of Epidemiology, 42*, 65–75. https://doi.org/10.1093/ije/dyr206.

Morton, S. M. B., Atatoa Carr, P. E., Grant, C. C., Berry, S. D., Marks, E. J., Chen, X. M-H., & Lee, A. C. (2014). *Growing up in New Zealand: A longitudinal study of New Zealand children and their families. Vulnerability report 1: Exploring the definition of vulnerability for children in their first 1000 days*. University of Auckland: Growing Up in New Zealand.

Morton, S. M. B., Atatoa Carr, P. E., Grant, C. C., Berry, S. D., Mohal, J., Pillai, A. (2015a). *Growing up in New Zealand: A longitudinal study of New Zealand children and their families. Vulnerability report 2: Transitions in exposure to vulnerability in the first 1000 days of life*. University of Auckland: Growing Up in New Zealand.

Morton, S., Ramke, J., Kinloch, J., Grant, C. C., Carr, P. A., Leeson, H., ... & Robinson, E. (2015b). Growing up in New Zealand cohort alignment with all New Zealand births. *Australian and New Zealand Journal of Public Health, 39*, 82–87. https://doi.org/10.1111/1753-6405.12220.

Newcomb, M. D., Maddahian, E., & Bentler, P. M. (1986). Risk factors for drug use among adolescents: Concurrent and longitudinal analyses. *American Journal of Public Health, 76*, 525–531. https://doi.org/10.2105/AJPH.76.5.525.

Odgers, C. L., Milne, B. J., Caspi, A., Crump, R., Poulton, R., & Moffitt, T. E. (2007). Predicting prognosis for the conduct-problem boy: Can family history help? *Journal of the American Academy of Child & Adolescent Psychiatry, 46*, 1240–1249. https://doi.org/10.1097/chi.0b013e31813c6c8d.

Poulou, M. S. (2015). Emotional and behavioural difficulties in preschool. *Journal of Child and Family Studies, 24*, 225–236.

Rutter, M. (1979). Protective factors in children's responses to stress and disadvantage. *Annals Academy of Medicine, 8*, 324–338.

Rutter, M. (1981). Stress, coping, and development: Some issues and some questions. *Journal of Child Psychology and Psychiatry, 22*, 323–356. https://doi.org/10.1111/j.1469-7610.1981.tb00560.x.

Sabates, R., & Dex, S. (2012). Multiple risk factors in young children's development. Centre for Longitudinal Studies, Institute of Education, University of London, United Kingdom.

Salmond, C. E., Crampton, P., & Atkinson, J. (2007). NZDep2006 index of deprivation. In *Department of Public Health*. New Zealand: Wellington School of Medicine and Health Sciences.

Sameroff, A. J. (1998). Environmental risk factors in infancy. *Pediatrics, 102*, 1287–1292.

Sameroff, A. J., Seifer, R., Zax, M., & Barocas, R. (1987). Early indicators of developmental risk: Rochester longitudinal study. *Schizophrenia Bulletin, 13*, 383–394. https://doi.org/10.1093/schbul/13.3.383.

Sameroff, A. J., Seifer, R., & McDonough, S. C. (2004). Contextual contributors to the assessment of infant mental health. In R. DelCarmen-Wiggins & A. Carter (Eds.), *Handbook of infant, toddler, and preschool mental health assessment* (pp. 61–76). New York, NY: Oxford University Press.

Van Leeuwen, K., Meerschaert, T., Bosmans, G., De Medts, L., & Braet, C. (2006). The strengths and difficulties questionnaire in a community sample of young children in Flanders. *European Journal of Psychological Assessment, 22*(3), 189–197. https://doi.org/10.1027/1015-5759.22.3.189.

Warnick, E. M., Bracken, M. B., & Kasl, S. (2008). Screening efficiency of the child behaviour checklist and strengths and difficulties questionnaire: A systematic review. *Child and Adolescent Mental Health, 13*, 140–147. https://doi.org/10.1111/j.1475-3588.2007.00461.x.

Webster-Stratton, C., Jamila Reid, M., & Stoolmiller, M. (2008). Preventing conduct problems and improving school readiness: Evaluation of the incredible years teacher and child training programs in high-risk schools. *Journal of Child Psychology and Psychiatry, 49*, 471–488. https://doi.org/10.1111/j.1469-7610.2007.01861.x.

Yoshikawa, H., Aber, J. L., & Beardslee, W. R. (2012). The effects of poverty on the mental, emotional, and behavioral health of children and youth: Implications for prevention. *American Psychologist, 67*, 272–284. https://doi.org/10.1037/a0028015.